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Seeding Rates, Cultivars, and Planting Methods for SMALL PROCESSING ONIONS *(Alium cepa L.)*

By H. J. Hopen
and C. E. Peterson

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN
COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION

Contents

This bulletin was prepared by H. J. Hopen, associate professor, Department of Horticulture, University of Illinois, and C. E. Peterson, Horticulturist, Agricultural Research Service, U.S. Department of Agriculture, Madison, Wisconsin. The assistance of Walter Staszak, Drug and Horticulture Station, University of Illinois, and of Onion Specialties of South Holland, Illinois, are gratefully acknowledged.

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SEEDING RATES, CULTIVARS, AND PLANTING METHODS FOR SMALL PROCESSING ONIONS

The majority of small processing onions (*Allium cepa* L.) consumed in the U.S. are imported from Holland or Italy (*3*). Processing of small onions in the U.S. is located primarily in the traditional onion-set production areas. Greater domestic production of small processing onions appears to be possible. Modern field and processing technology and equipment has been developed by a small group of growers and grower-processors. Crystal Wax was the cultivar of comparison, as it is the major commercial cultivar used in the production area of Northeastern Illinois and Southeastern Wisconsin, which was the area in which the studies were conducted.

It is known that short days promote top growth and inhibit bulb formation. Long days induce early bulb formation and better bulb growth at early stages, while simultaneously inhibiting leaf growth (*2,7*). Leaf emergence ceases immediately after the onset of bulbing (*2*). The critical photoperiod for bulbing usually varies between 12 and 16 hours of light per day, depending on the cultivar (*6*). Manuel and Velasco (*7*) found that bulbs from plants that received short days (9 hours) were smaller and weighed less than bulbs from plants receiving 12 or 15 hours of light.

The size and shape of the onion determines if it is used for mixed vegetable products, cocktail onions, pickle products, or soups and stews. The ideal small to intermediate size of processing onion is white, globe-shaped, and with a small neck and root zone (*3*). To obtain small bulbs for processing, seeds are planted at a uniform, high rate (*3*). Short-day cultivars are used under northern U.S. conditions since they will bulb sooner than long-day cultivars if planted in April or early May when long days prevail (*6*). It has been established that the bulbing of *Allium cepa* L. is determined by the interaction of photoperiod, age of plant, and a favorable temperature for bulb induction (*8,9*).

Numerous studies on optimum plant populations for dry bulb onions (over 5 cm in diameter) have been reported (*3,5*). In the only study located on pickling onions (in Venezuela), Crystal White Wax and Crystal Wax had the best confirmation of six cultivars evaluated. White Granex and White Granex PRR had the greatest yields (*1*).

Materials and Methods

Experiments were conducted for three years, 1970 to 1972, to evaluate the range of onion sizes and types that could be grown for the domestic market and to determine the influence of plant population, depth, and method of planting on size, shape, and total yield. These studies were conducted at the University of Illinois Drug and Horticulture Experiment Station at Downers Grove on a Drummer silty clay loam soil.

Split-plot randomized designs with three to five replicates were used in 1970 and 1971, with single-row plots 3.08 m long and 25 cm between rows. Cultivars were main-plot treatments, and seeding rates were split-plots. Preliminary studies on a grower's field in 1969 are not reported here. Cultivars evaluated in 1970 were Crystal Wax, Barletta, Konigen, Queen, Pompei, and Gladalin White. Cultivars in 1971 were Crystal Wax, Pompei, and Gladalin White. Seeding rates in 1970 were 44.2, 67.2, 89.6, and 112.0 kg/ha. Only the three lower rates were evaluated in 1971. The theoretical number of seeds per m were 380, 565, 750, and 945 at 44.2, 67.2, 89.6, and 112.0 kg/ha respectively. The usual commercial seeding rate is about 40 kg/ha. One pound (454 g) of onion seeds contains about 152,000 seeds (*4*). Individual cultivar counts varied slightly, but were in general agreement with the published figure.

All planting was with a V-belt seeder at a depth of about 2 cm, except in 1972. In 1972 Crystal Wax at 67.2 kg/ha was seeded in a row at 7.5, 2.5, and both 7.5 and 2.5 cm depths. Seeds at the same depths were also scattered to a 7.5 cm horizontal width with a hand garden rake. Where seed was placed at both 2.5 and 7.5 cm depths, one-half of the seeding rate was placed at each depth. A randomized complete block design was used in 1972.

Two seeding dates were evaluated in each of the three years, with the initial dates varying because of seasonal variation of soil temperature and rainfall. Dates of seeding were: 1970, April 23 and May 4; 1971, April 8 and 26; and 1972, April 18 and May 5.

In all three years the bulbs from each plot were separated with a wooden bar grader into the following diameter sizes: less than 6.5 mm, 6.5 to 9.5 mm, 9.5 to 12.5 mm, 12.5 to 15.5 mm, 15.5 to 19 mm, 19 to 25.5 mm, and more than 25.5 mm. Total bulb number and weight in each size range were determined.

Results and Discussion

Crystal Wax was later maturing than the other five cultivars grown in 1970 and 1971 (Table 1). There were no significant yield differences for cultivars in 1970. However, in 1971 Crystal Wax had the largest total yields at both planting dates (Table 2). Interactions between seeding rate and cultivar were not significant in 1970 or 1971. The Barletta cultivar produced flat bulbs when seeded at the 44.2 kg/ha. Present market

Table 1. — Cultivar Maturity at Harvest in 1970 and 1971

Cultivar	1970[a]		1971[b]	
	Planting 1	Planting 2	Planting 1	Planting 2
Crystal Wax	2.0 A[c]	1.9 a[c]	53 a[c]	7 A[c]
Pompei			100 b	100 B
Barletta	1.4 AB	1.1 b		
Konigin	1.8 AB	1.7 a		
Queen	1.0 A	1.0 b		
Gladalin White	1.5 AB	1.2 ab	100 b	100 B

[a] August 3, 1970, maturity rating: 1 = row was down; 2 = row was standing.
[b] July 28, 1970, maturity rating, based on the percent of the row that was down.
[c] The numbers in the columns are means. The numbers within a column which are not followed by common letters are significantly different by Duncan's multiple-range test at the 5-percent level (lower case letters) or 1-percent level (upper case letters).

Table 2. — Cultivar Yields in 1971

Cultivar	April 8 planting		April 26 planting
	Extrapolated number of bulbs/ha	Extrapolated metric tons/ha	Extrapolated metric tons/ha
Crystal Wax	2,479,304 A[a]	17.9 A[a]	13.3 A[a]
Pompei	2,322,761 AB	12.4 BC	10.0 BC
Gladalin White	2,157,756 B	15.4 AB	12.3 AB

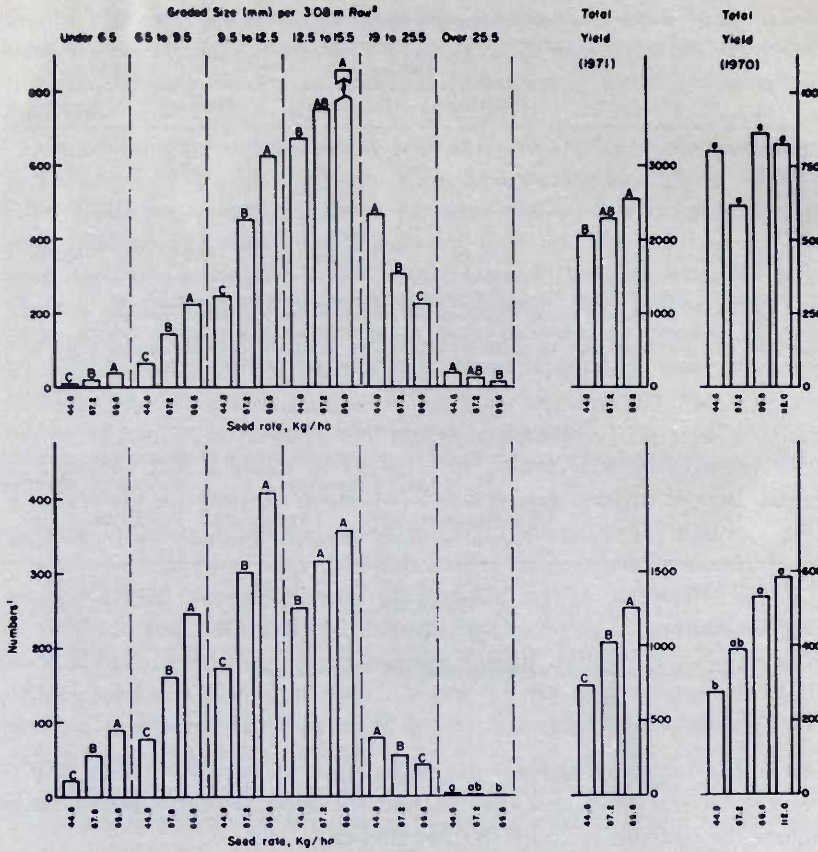
[a] Mean separation by Duncan's multiple-range test, 1-percent level.

demand is for round onions; flat bulbs result in excessive waste in processing. Crystal Wax and Pompei had the most desirable round shape among the cultivars included in these studies.

The 1970 size distribution was different between 44.8 kg/ha and any of the other seeding rates (67.2, 89.6, and 112 kg/ha). Early yields followed the same size distribution as late yields described in Figure 1. The 112 kg/ha seeding rate was dropped in 1971 because in 1970 it did not significantly differ from the 67.2 and 89.6 kg/ha rates.

In 1970 and 1971 the lower plant population resulted in a greater number and weight of larger bulbs. At the higher seeding rates there was a greater number of small bulbs (Fig. 1). The number and weight of bulbs in the middle range could not be shifted by plant populations used in these studies. The middle range was usually 15.5 to 19.5 mm. The 89.6 and 112.0 kg/ha seeding rates produced a greater number and weight of onions below the 12.5 mm to 15.5 mm size. A greater number and weight of bulbs in the sizes larger than 12.5 to 15.5 mm resulted from the 44.8-kg/ha seeding rate.

Size and weight of small processing onions can be controlled by seed-



Bulb-size distribution for 1971 late planting, and total yields for 1970 and 1971 late plantings, as influenced by seeding rate. The 15.5- to 19.0-mm size was not significantly different at the 5-percent level. Mean separation within a size range by Duncan's multiple-range test: capital letters, 1-percent level; lowercase letters, 5-percent level. (Fig. 1)

ing rate (Tables 3 and 4). If onions of 19 mm or larger are to be produced, a seeding rate of 44.2 kg/ha or less should be used. If bulbs in the 6.5 to 15.5 mm size range are desired, a seeding rate of 89.6 kg/ha was most satisfactory in these studies. Currently there is little demand for bulbs of less than 6.5 mm size. The number of bulbs produced in this range was small even at the 112 kg/ha seeding rate.

In 1972 an attempt was made to alter bulb size by distributing the seeds vertically (varying the seeding depth) and horizontally (scattering the seeds). With this system, a significantly different distribution in num-

Table 3. — Average Onion Bulb Weight (g) at Four Seeding Rates

kg seed/ha	Early plantings		Late plantings	
	1970	1971	1970	1971
44.8	3.56	3.48	2.93	2.78
67.2	2.67	2.61	1.56	2.21
89.6	1.95	2.33	1.63	2.02
112.0	1.71		1.42	

Table 4. — Average Onion Bulb Weight (g) in Row and Scattered Plantings

Seeding treatments at 67.2 kg/ha	1972 May 5 planting
7.5 cm (row)	7.63
2.5 cm (row)	5.69
7.5 and 2.5 cm (row)	11.73
7.5 cm (scattered)	14.71
2.5 cm (scattered)	6.77
7.5 and 2.5 cm (scattered)	11.09

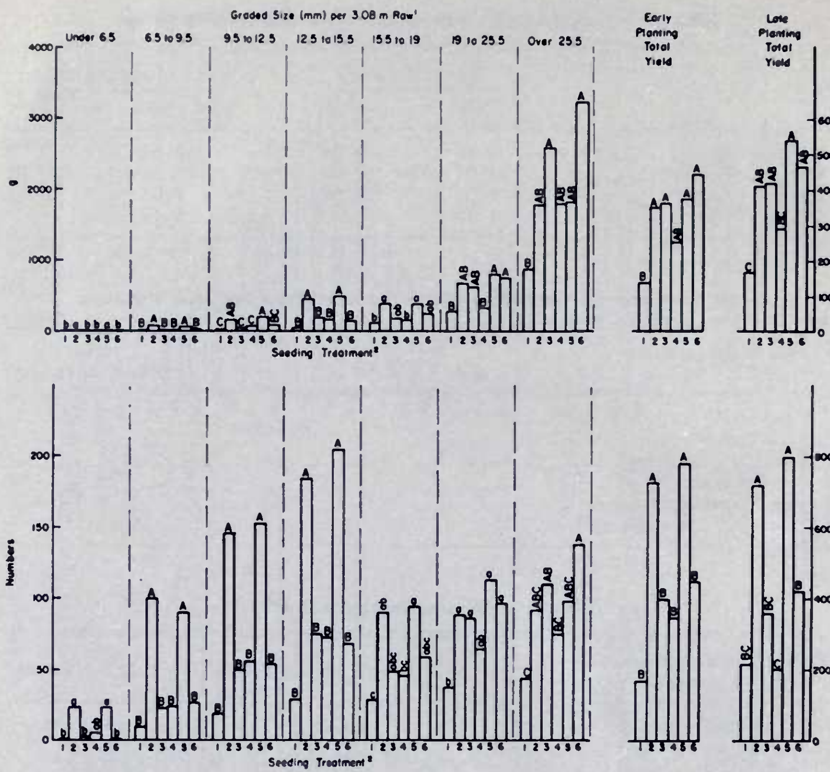
Table 5. — Days to Emergence in 1972

Planting method and depth of planting	April 18 planting	May 5 planting
7.5 cm (row)	27.0 a[a]	16.0 A[b]
2.5 cm (row)	21.0 b	13.0 B
7.5 and 2.5 cm (row)	21.5 b	13.8 B
7.5 cm (scattered)	22.5 b	13.8 B
2.5 cm (scattered)	21.0 b	13.0 B
7.5 and 2.5 cm (scattered)	22.0 b	14.5 AB

[a] Mean separation by Duncan's multiple-range test, 5-percent level.
[b] Mean separation by Duncan's multiple-range test, 1-percent level.

ber and weight of bulbs was obtained in the 12.5 to 19 mm sizes. This is the range that was not influenced by in-the-row seeding rates in 1970 and 1971. Below the 19 mm size the early planting had the greatest number and weight of bulbs, except at the 7.5 cm-depth, where higher soil temperature in the later planting apparently favored germination and emergence from this depth (Fig. 2).

Shallow seeding (2.5 cm) resulted in earliest and greatest emergence (compared with 7.5 cm), with consequently greater numbers and usable weights of bulbs. The time to emergence was greater with deeper planting, which is an indication of stress on the emerging onion seedling (Table 5). Larger bulbs were produced by the 2.5-cm scatter planting (more physical room for development) than with the 2.5-cm row-seeding,



Bulb-size distribution for 1972 early planting, and total yields for early and late plantings, as influenced by seeding depth and by row and scatter methods of seeding. Mean separation within a size range by Duncan's multiple-range test: capital letters, 1-percent level; lower-case letters, 5-percent level. Seeding treatment: 1 — 7.5 cm (row); 2 — 2.5 cm (row); 3 — 7.5 and 2.5 cm (row); 4 — 7.5 cm (scattered); 5 — 2.5 cm (scattered); and 6 — 7.5 cm and 2.5 cm (scattered). (Fig. 2)

which resulted in a slightly larger total yield (Table 6). The 7.5-cm depth of planting produced comparatively larger total yields, but primarily of bulbs 25.5 mm or larger.

Scattering the seeds appears to be a more useful practice than varying planting depth, as better yield and size distribution were obtained. Scattering the seeds would require an increased seeding rate to maintain the same size distribution.

Horizontal seed distribution (scattering) tended to produce a larger bulb than the same seeding rate placed in a row. Further studies are

Table 6. — Comparison of Yields at Early and Late Planting Dates (extrapolated metric tons/ha)

Seeding rate and treatment	Early planting			Late planting		
	1970	1971	1972	1970	1971	1972
44.2 kg/ha	2.36	13.66		4.21	10.61	
67.2 kg/ha, row, 2.5 cm	3.06	14.75	18.27	3.55	11.72	21.38
67.2 kg/ha, row, 7.5 cm			7.07			8.53
67.2 kg/ha, row, 2.5 and 7.5 cm			18.90			21.87
67.2 kg/ha, scattered, 2.5 cm			19.47			28.20
67.2 kg/ha, scattered, 7.5 cm			13.14			15.14
67.2 kg/ha, scattered, 2.5 and 7.5 cm			23.17			24.32
89.6 kg/ha	3.57	17.31		4.53	13.27	
112.0 kg/ha	3.34			4.30		

needed to evaluate the effect of horizontal distribution on size of bulbs and yield of marketable product.

The late-planted treatments in 1970 and 1972 yielded greater weight of bulbs than early plantings. In contrast, the 1971 early planting had greater yields than the late planting (Table 6). Number of bulbs was greatest for the early planting in 1971 (Fig. 1), and for the later plantings in 1970 and 1972 (Fig. 2).

Soil temperatures were higher in early April of 1971 than 1970 or 1972, and onions were seeded earlier. The earlier seeding and exposure to a shorter day length undoubtedly caused the early 1971 seeding to have a greater yield than 1970 or 1972 early plantings. The early planting 1971 plants had more foliage growth before bulb induction. However, even the April 8, 1971, seeding date was not early enough to allow maximum vegetative growth before the onion seedlings were activated to bulb because, as stated in the literature review, long days induce early bulb formation and better bulb growth at early stages, while simultaneously inhibiting leaf growth with smaller plants resulting. In most growing seasons, onions cannot be seeded earlier than (or as early as) the first week in April in this area. In 1970 and 1972 the soil temperature did not reach a level adequate for onion germination until later in the season. This subjected the early planted onions to a longer photoperiod than in 1971. This longer photoperiod, plus slower germination and growth of the early plantings, produced lower yields in 1970 and 1972. The late plantings were planted in a warmer soil and had more rapid and uninterrupted growth.

Suitable small, whole, processing onions, now imported in large volume, can be produced in the northern Illinois production area, where these experiments were conducted. Size, shape, and yield are influenced by variety, plant population, and seed distribution. The cv. Crystal Wax, seeded at 89.6 kg/ha with horizontal distribution (scattered), produced the most desirable crop, with a high proportion of the sizes in demand for mixed vegetables, cocktail onions, and pickles.

Summary

Ten cultivars, with seeding rates of 44.2, 67.2, 89.6, and 112.0 kg/ha and vertical and horizontal distribution of seeds, were evaluated in an attempt to alter the size and shape of small processing onions (*Allium cepa* L.). Crystal Wax, currently the main commercial cultivar, produced the most desirable shape and yields. As seeding rate increased, bulb size decreased, but total yields were not consistently affected by the seeding rate. Horizontal dispersion of onion seeds produced larger bulbs when compared with identical rates seeded in a row.

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